

Managing the Uncertainties of Forest Climate Benefits

Bill Stewart

UC Forestry Specialist

stewart@nature.berkeley.edu

Sacramento, July 2008

Board of Forestry and Fire Protection



Forests and forest products provide significant climate benefits now and could provide more cost-effective benefits with additional investments

- BOF lead must cut across various themes
 - Sustainable Forests
 - Renewable Energy
 - Energy efficient buildings





The sources of uncertainties

<http://www.ipcc.ch/>



1. The Physical Science Basis

- Radiative forcing v CO_2 flux v C
- Direct changes v Indirect shifts

2. Impacts, Adaptation and Vulnerability

- What about losses due to climate change?

3. Mitigation of Climate Change

- Who pays, who is the referee?





Three Different Areas of Uncertainty

- The whole forests and produce cycle – or 1/2?
 - ‘Let Grow’ v ‘Managed’ forests are very different in growth per year but similar in fire risk loss
- Physical systems
 - How will forests react to changing climates
 - How will forest products compete with alternatives
- Economic systems
 - When will the ‘cap’ drop?
 - When will the ‘tax’ rise?
 - How will CO₂e rules affect forest product and forest land prices?





Different Forest:Climate Links (Million Acres)

Owner	Forest Management	Let Grow	Fire Protection	Technical Assistance
Commercial	4	0	4	4
Family	2	6	8	8
USFS managed	4	0	4	4
Federal Other	0	16	16	16
Total	10	22	32	32

2008 CEC-PIER Scenarios Project

– science, impacts & adaptation,
then mitigation

- Use common suite of potential future climate scenarios
- Use common suite of potential land use and economic scenarios
- Look across all natural resource sectors
- Water, Energy, Agriculture, Coastal, Air Quality, Public Health, Forests



Forest Studies CEC Scenarios Project

- Forest Productivity (UC Berkeley)
 - Forest Economics (UC Santa Barbara)
 - Forest Biodiversity (UC Santa Barbara)
 - Forest Wildfires (UC Merced)
-
- Each focuses on a different set of predictions and uncertainties



Forest climate benefits and uncertainties

- Managed forests can be modeled with empirical data
- Future markets and price estimates are less accurate
- Future risks and adaptations across all forests due to hotter and drier scenarios - less certainty
 - Wildfire impacts
 - Change in optimal conditions for species



Forest Productivity and Future Climates (UCB)

- Dissect historical variability of observed growth and mortality to model impact of drier and hotter conditions from climate scenarios
- Consider forest management options to increase forest stand resiliency –
 - Different seed provenances (hotter and drier)
 - Different species mix
 - Different stocking densities

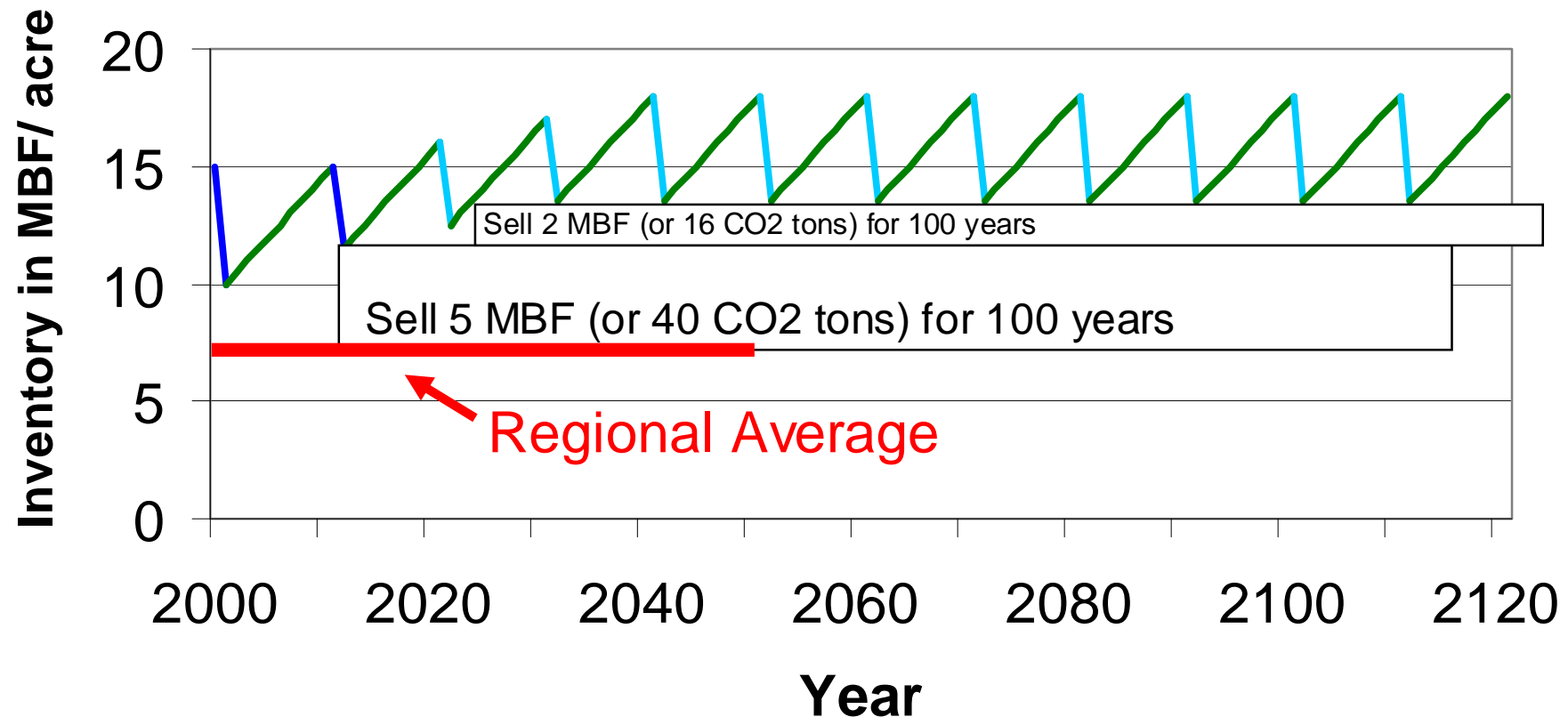


New Zealand to make Forests Plantations Kyoto-eligible

- Well understood growth patterns
- Introducing July 2008 legislation to make forestry the leader for offset trading
- Baseline measurements
- Sell carbon offsets above 'baseline'
- Pay fee to permanently convert forest plantations to other uses
- <http://www.climatechange.govt.nz/nz-solutions/forestry.shtml>

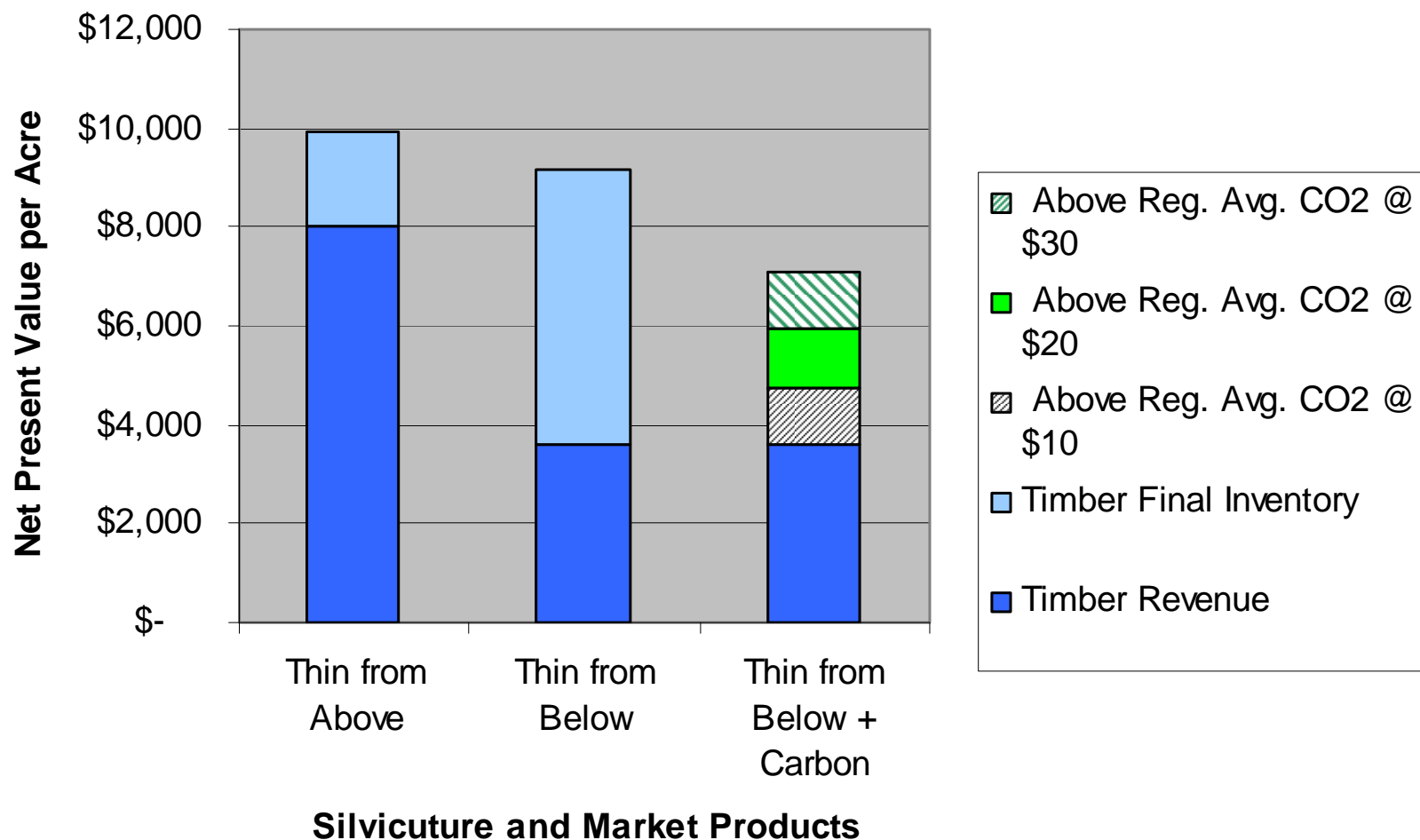


Selling Forest Carbon from a Working Forest under a Regional Average Approach



Future timber or future carbon contracts?

It depends on prices





At what price is carbon mgt=timber mgt?

CA 2008/ 2 nd half	South- east US	If \$/mbf =	Then \$/CO2 ton is an equal deal
	Pulp- wood	50	6
Fir	Chip-n- Saw	100	13
Doug. fir		150	19
Pine	Pine	200	25
		250	31
Redwood		600	75

BUT there are risks to storing a lot of carbon in natural forests

- One outbreak of one beetle has shifted Canadian forests from a net sink to a net source for the next 10 – 20 years
- Beetles are moving across the Canadian boreal forests and into US montane forests



A Very Large Forest Disturbance: Mountain Pine Beetle in BC and Beyond

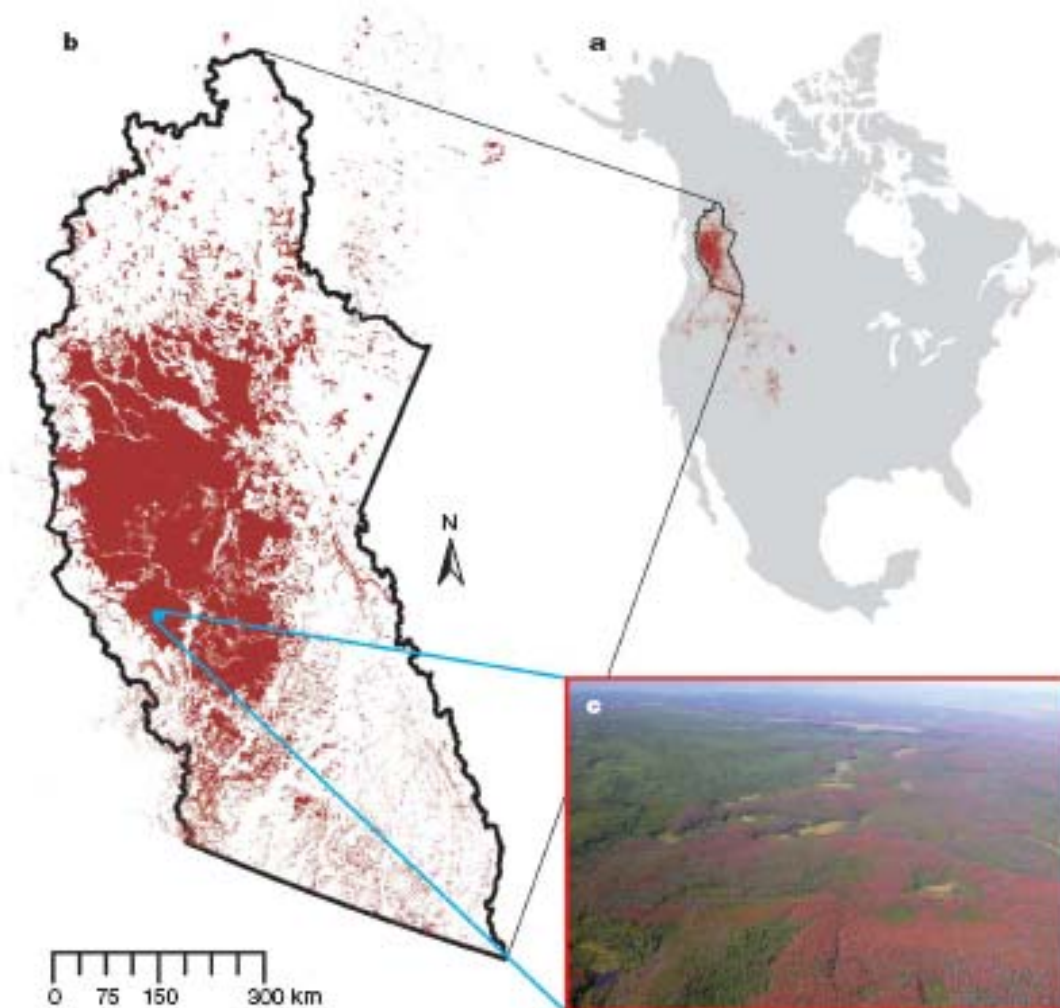
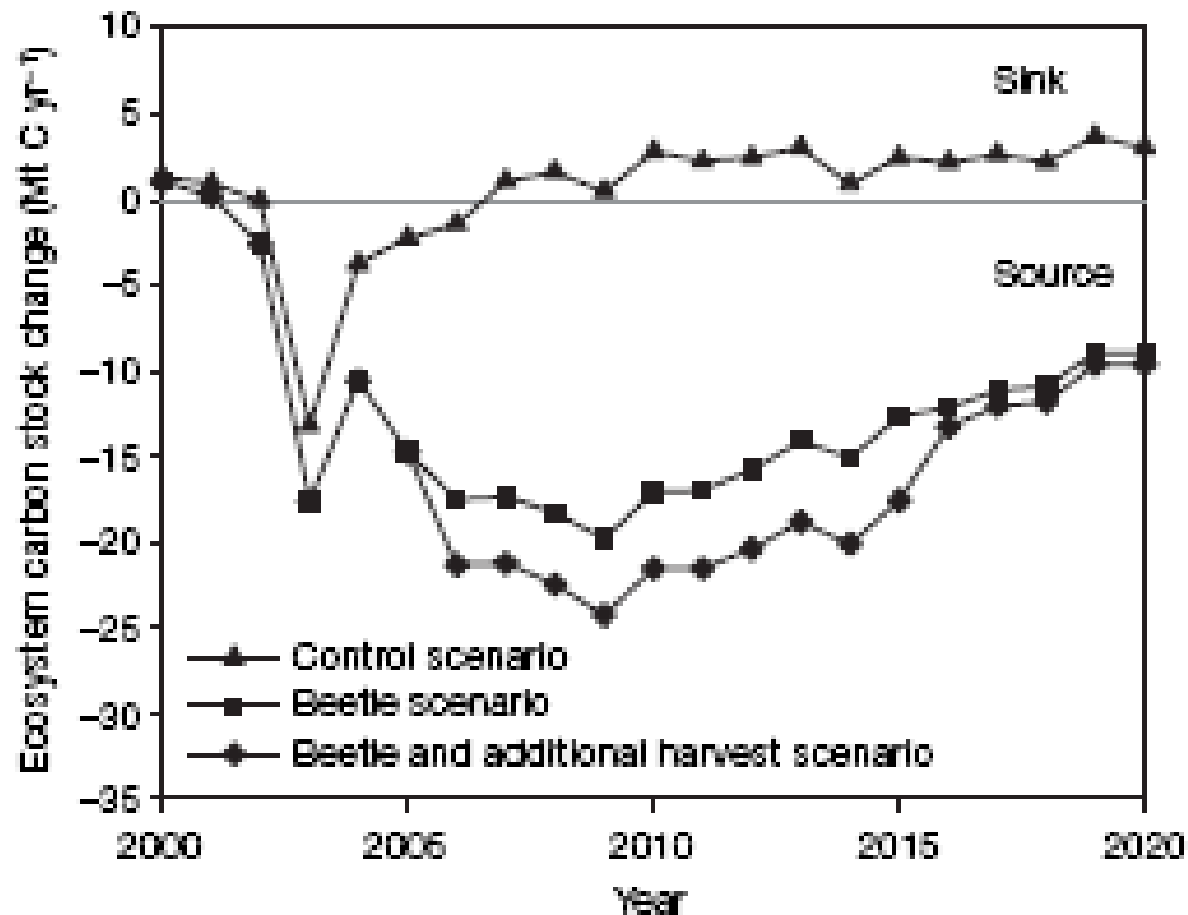


Figure 1 | Geographic extent of mountain pine beetle outbreak in North America. a, Extent (dark red) of mountain pine beetle. b, The study area includes 98% of the current outbreak area. c, A photograph taken in 2006

showing an example of recent mortality: pine trees turn red in the first year after beetle kill, and grey in subsequent years. Photo credit: Joan Westfall, Entopath Management Ltd.

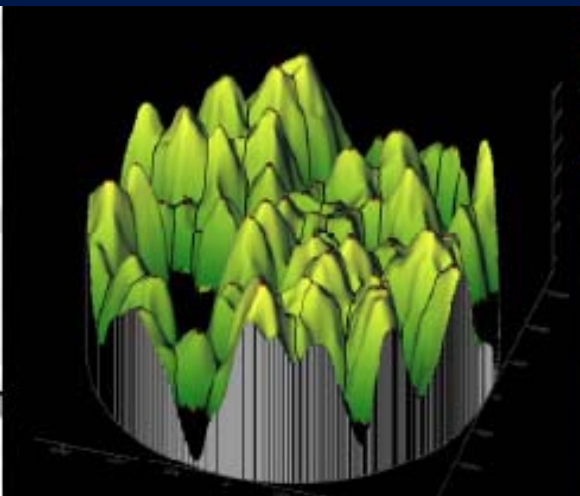
Massive Quantities of Dead Trees and Slash will Decompose in BC: Will Dwarf Estimated Storage



Need to measure forest biomass, not just acres in the forest

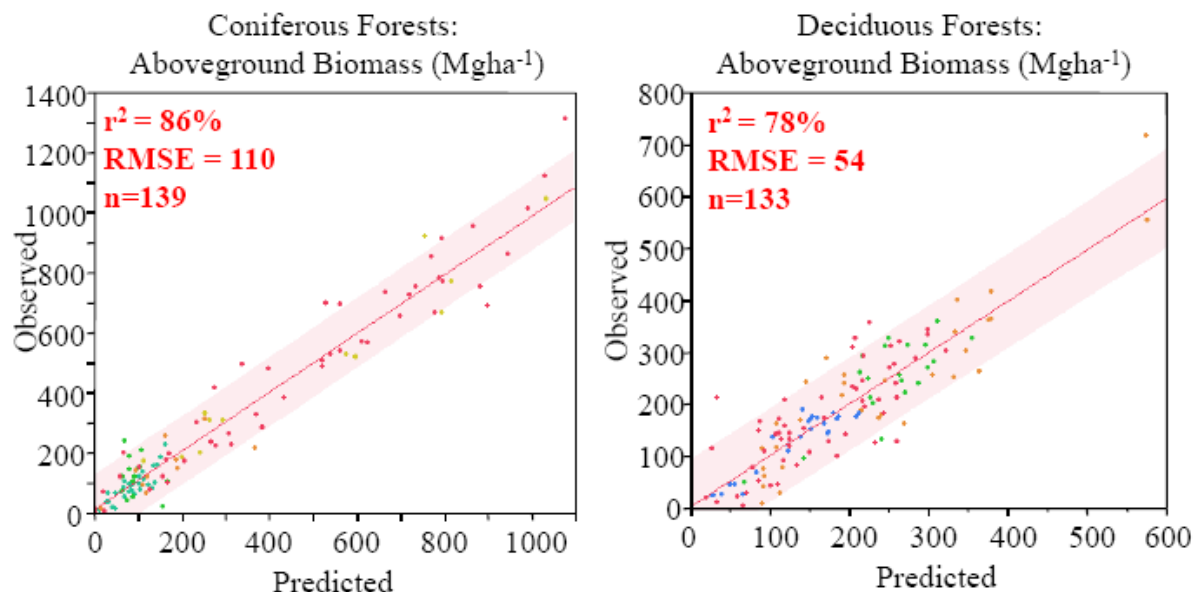
- Go from plot data to look-up tables built from bigger samples
- Satellite based Lidar could give 100% samples at specified intervals
 - Woods Hole
 - U Maryland
 - U Minnesota





Take a lidar view of the volume of the forest and convert it into a biomass estimate

What biomass accuracies have been observed?

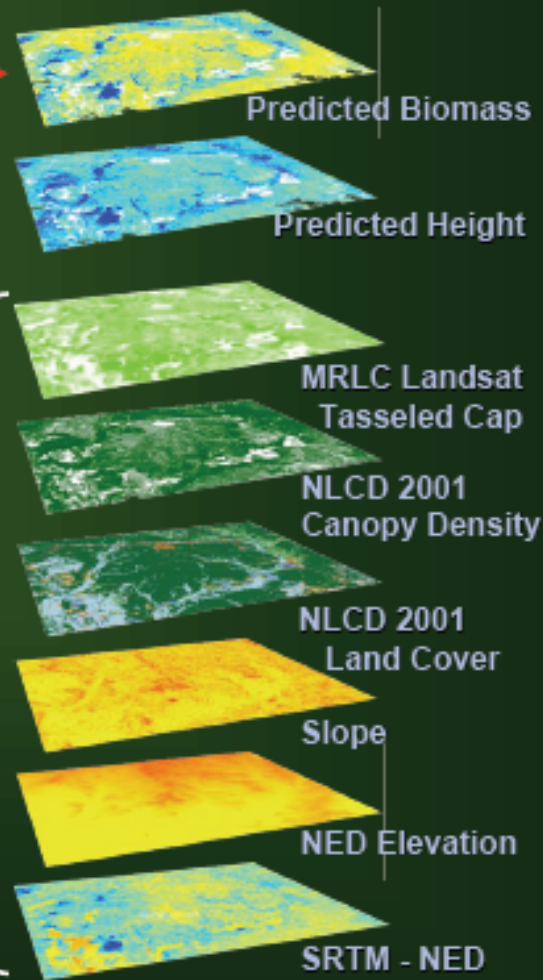
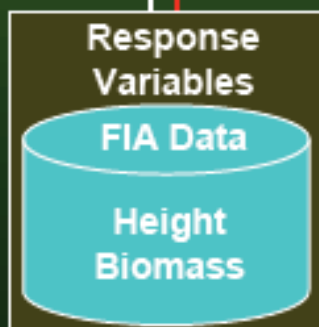


■ To reduce the errors to 10 tC/ha requires ~ 7 - 25 samples





Modeling Approach



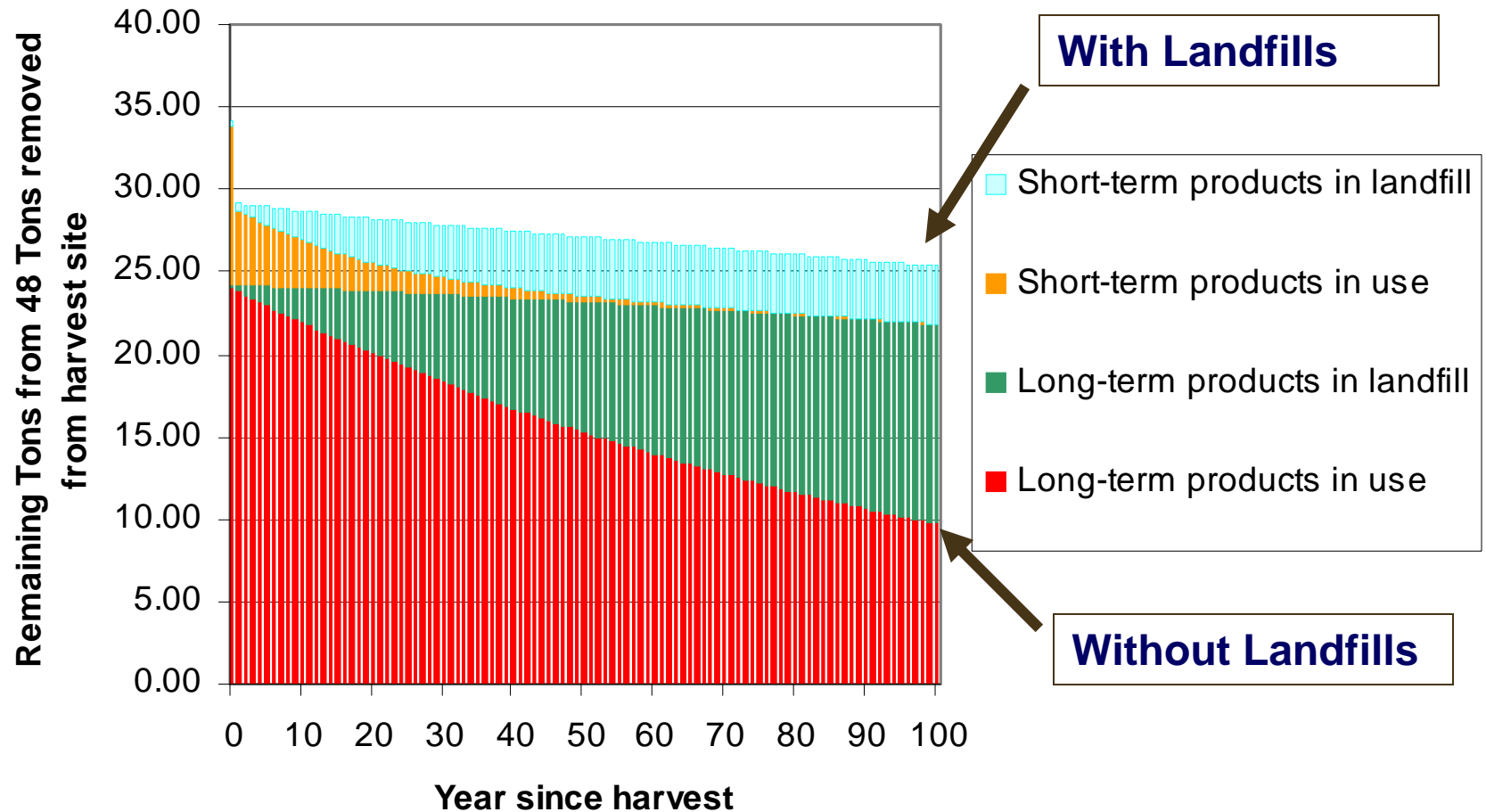
Kellendorfer et al., 2008

Uncertainties in Carbon Storage in Wood Products and Landfills

- With 80% of wood products imported, the total storage is greater than California production
- How long wood products are in use is up to builders and remodelers
- How efficient the waste wood to engineered landfill or bioenergy transition?
- California has a more efficient system than the US, but we lack life cycle studies



Sequestration of Wood Products in use and in landfills - 2/3 of 100 year sequestration is in landfills



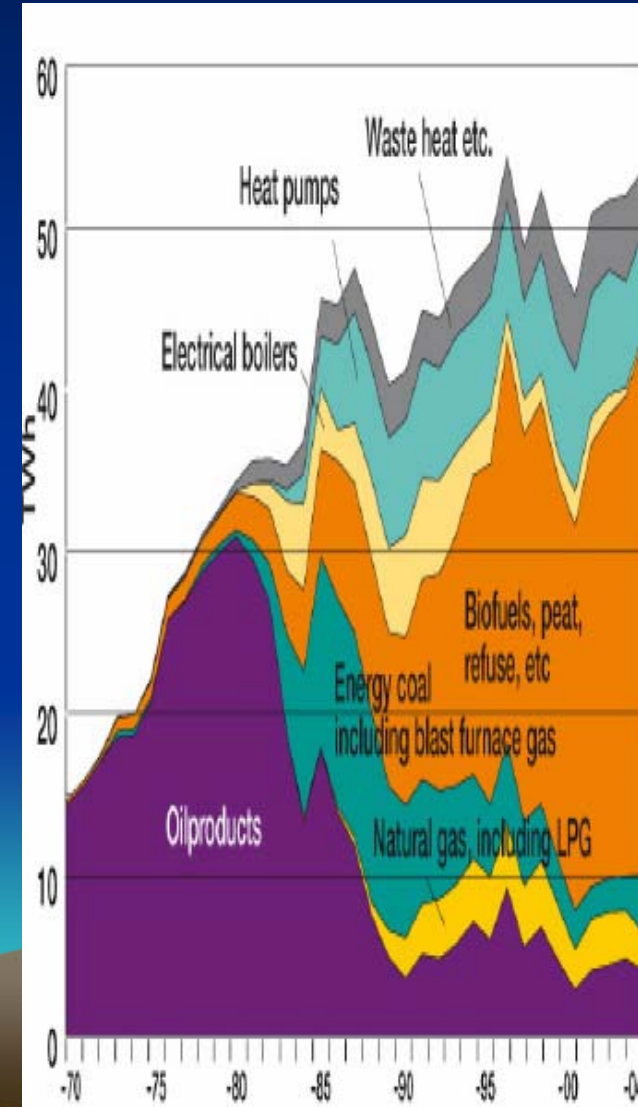
Based on paper recycling, some wood recycling, and eventual delivery to landfills
ST – short term products (eg paper) LT – long term products - lumber

Wood Chips to Bioenergy: The least charismatic benefit

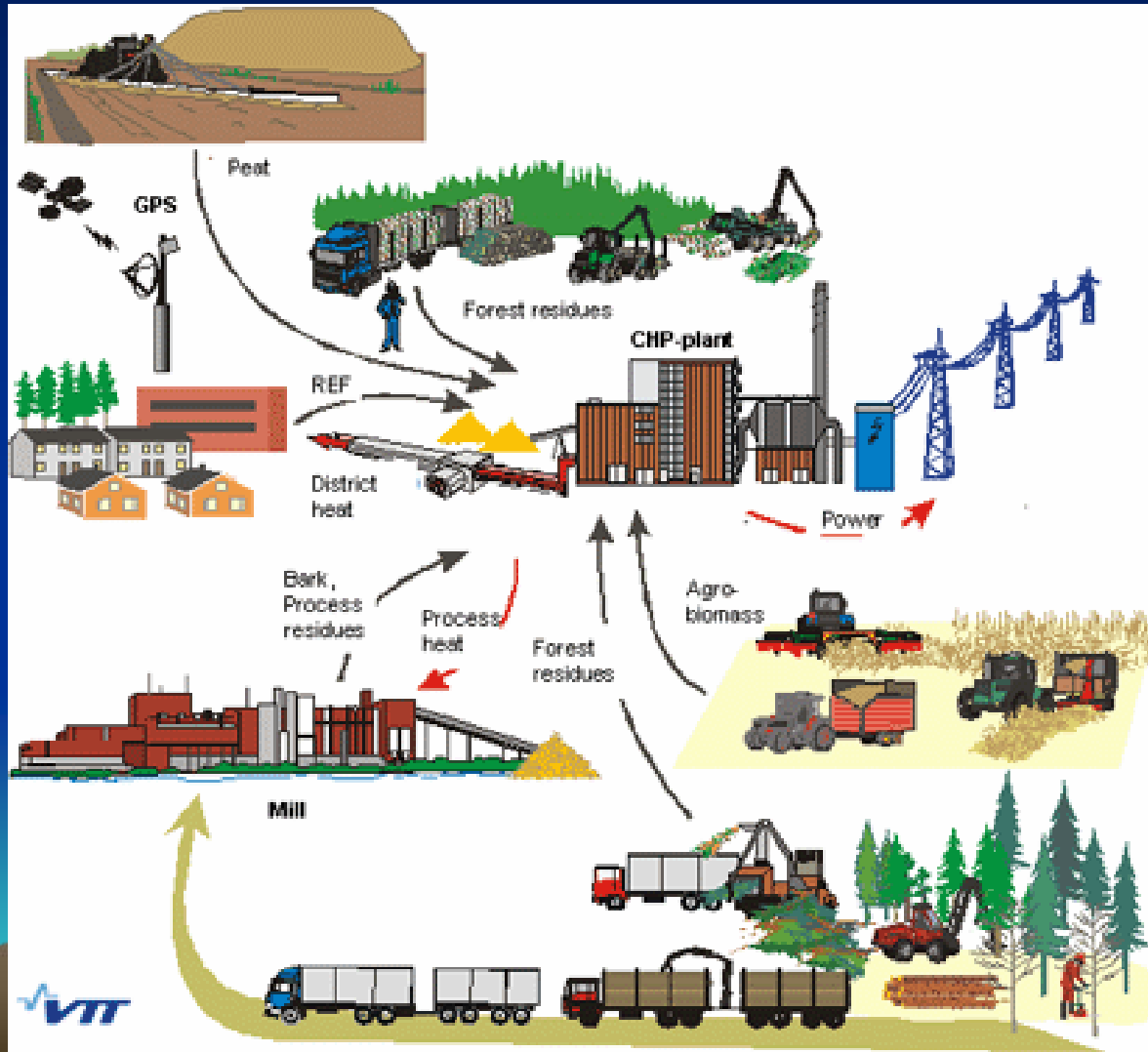
- But it is the only Kyoto-approved type of forestry climate benefits accepted in Europe
 - Sweden
 - Finland
 - Denmark
 - Austria



Sweden: Oil to Wood for District Heating in 25 years



Finland: 20% of electricity and Kyoto Protocol obligations with wood chips



Total Forest Climate Benefits =

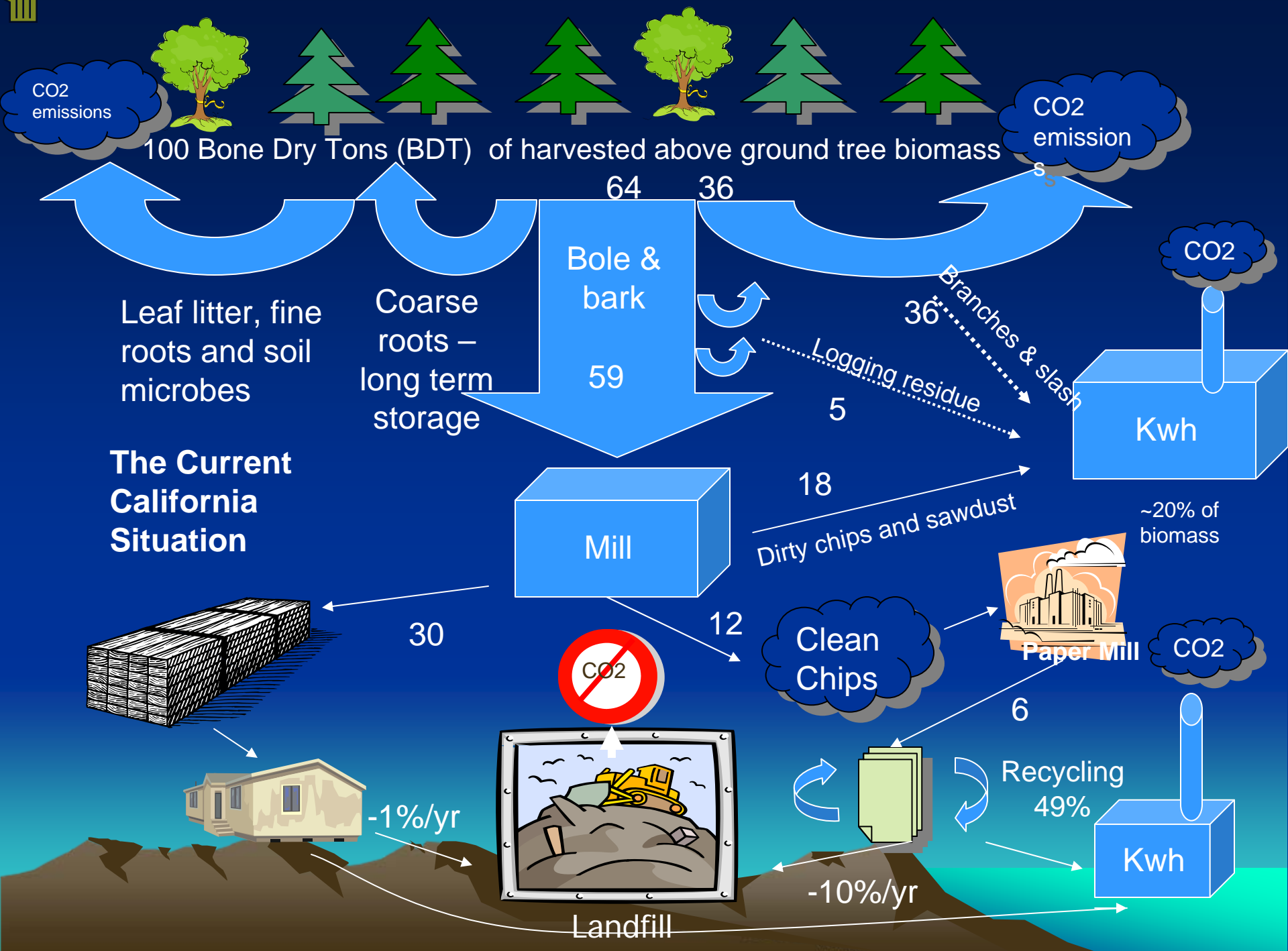
- **Carbon storage**

- 1) In the forest (climatic conditions and new threats)
- 2) In the products (when they are thrown away)
- 3) In the landfill (how good is the landfill)

- **Energy Substitution**

- 1) From the forest – biomass chips (renewable electricity)
- 2) From the products – energy efficiency in construction
- 3) From the landfill or alternative - bioenergy facilities

Over 100 years most of these variables are outside the control of the forest manager , with uncertainties beyond forest growth models



Addressing Uncertainties

- Little uncertainty about the 5 MMT CO₂e historic level of annual climate benefits
- Need cheap, accurate and comparable measurements of in-forest carbon across all 32 million acres – Lidar looks very promising
- Need more accurate measurements of the life cycle of products and landfills for new building product guidelines
- Need AB32 goal-oriented pricing and contracts to do what Sweden and Finland have done with bioenergy and follow New Hampshire and RGGI

